CLAIMS

What is claimed is:

1. A sleeve element for sealing between a piston element surface and a bore surface disposed thereabout comprising:

a substantially annular body including an inner surface, an outer surface, a first end region, and a second end region;

wherein at least a portion of the first end region of the substantially annular body is configured to be biased laterally into at least one recess formed in one of the piston element surface and the bore surface; and

at least one sealing feature formed on the substantially annular body proximate to the portion of the first end region configured to be biased laterally into at least one recess, the at least one sealing feature sized and configured to sealingly engage against the other of the piston element surface and the bore surface.

2. The sleeve element of claim 1, wherein at least a portion of the substantially annular body is configured to be a bearing surface, the bearing surface sized and configured to conformally engage the other of the bore surface and the piston element surface.

3. The sleeve element of claim 1, wherein the substantially annular body comprises a material selected from the group consisting of polyamide, polytetrafluoroethelene (PTFE), acetal, polyethylene, and polyurethane.

4. The sleeve element of claim 1, wherein the substantially annular body is sized and configured to interferingly engage the piston element surface with the inner surface of the substantially annular body.

5. The sleeve element of claim 1, wherein the substantially annular body is sized and configured to interferingly engage the bore surface with the outer surface of the substantially annular body.

6. The sleeve element of claim 1, wherein the substantially annular body is formed of a material providing at least one of resilient elongation and resilient compression of about 2% or more.

7. The sleeve element of claim 1, wherein the at least one sealing feature comprises a first sealing feature configured to be biased laterally into a laterally adjacent first recess formed in the piston element surface in response to contact between the first sealing feature of the substantially annular body and the bore surface.

8. The sleeve element of claim 7, wherein:

the at least one sealing feature further comprises a second sealing feature;

at least a portion of the second end region of the substantially annular body is configured to be biased laterally into a laterally adjacent second recess formed in the piston element surface in response to contact between the second sealing feature of the substantially annular body and the bore surface; and

the second sealing feature is positioned proximate to the portion of the second end region configured to be biased laterally into the second recess.

9. The sleeve element of claim 8, further comprising:

a first depression and a second depression, each depression formed in the outer surface of the substantially annular body;

wherein the first depression is positioned proximate to the first sealing feature and the second depression is positioned proximate to the second sealing feature.

10. The sleeve element of claim 1, wherein the at least one sealing feature comprises a first sealing feature configured to be biased laterally into a laterally adjacent first recess formed in the bore surface in response to contact between the first sealing feature of the substantially annular body and the piston element surface.

11. The sleeve element of claim 10, wherein:

the at least one sealing feature comprises a second sealing feature;

at least a portion of the second end region of the substantially annular body is configured to be biased laterally into a laterally adjacent second recess formed in the bore surface in response to contact between the second sealing feature of the substantially annular body and the piston element surface; and

the second sealing feature is positioned proximate to the portion of the second end region configured to be biased laterally into the second recess.

12. The sleeve element of claim 11, further comprising:

a first depression and a second depression, each depression formed in the inner surface of the substantially annular body;

wherein the first depression is positioned proximate to the first sealing feature and the second depression is positioned proximate to the second sealing feature.

13. The sleeve element of claim 1, further comprising a depression formed in at least one of the outer surface and the inner surface of the substantially annular body.

14. The sleeve element of claim 13, wherein the depression is positioned proximate to the at least one sealing feature.

15. A seal assembly for sealing between a piston element surface and a bore surface disposed thereabout comprising:

a piston element having a surface;

a first sleeve element positioned between the piston element surface and a bore surface disposed thereabout, the first sleeve element having an inner surface, an outer surface, a first end region, and a second end region;

a second sleeve element positioned between the piston element surface and the bore surface, the second sleeve element having an inner surface, an outer surface, a first end region, and a second end region; and

a first recess and a second recess, wherein both the first and second recess are formed in the piston element surface;

wherein at least a portion of the first end region of the first sleeve element is laterally adjacent to the first recess and configured to be biased laterally thereinto;

wherein at least a portion of the first end region of the second sleeve element is laterally adjacent to the second recess and configured to be biased laterally thereinto;

wherein the first sleeve element includes a sealing feature extending from the outer surface thereof, proximate to the portion of the first end region configured to be biased laterally into the first recess, the sealing feature configured to sealingly engage against the bore surface disposed about the piston element surface; and

wherein the second sleeve element includes a sealing feature extending from the outer surface thereof, proximate to the portion of the first end region configured to be biased laterally into the second recess, the sealing feature configured to sealingly engage against the bore surface disposed about the piston element surface.

16. The seal assembly of claim 15, wherein the first sleeve element and the second sleeve element each comprise a material selected from the group consisting of polyamide, polytetrafluoroethelene (PTFE), acetal, polyethelene, and polyurethane.

17. The seal assembly of claim 15, further comprising:

a first depression formed in the first sleeve element; and

a second depression formed in the second sleeve element;

wherein the first depression is positioned proximate to the sealing feature of the first sleeve element and the second depression is positioned proximate to the sealing feature of the second sleeve element.

18. The seal assembly of claim 15,

wherein at least a portion of the outer surface of the first sleeve element is configured as a bearing surface and at least a portion of the outer surface of the second sleeve element is configured as a bearing surface.

19. The seal assembly of claim 18, wherein the bearing surface of the first sleeve element and the bearing surface of the second sleeve element are each sized and configured to conformally engage the bore surface.

20. The seal assembly of claim 15, wherein the first sleeve element and the second sleeve element each comprise a material providing at least one of resilient elongation and resilient compression of about 2% or more.

21. The seal assembly of claim 15, wherein the inner surface of the first sleeve element fits interferingly against the piston element surface and the inner surface of the second sleeve element fits interferingly against the piston element surface.

22. The seal assembly of claim 15, further comprising

a first retention flange formed in the piston element surface adjacent to the first end region of the first sleeve element and exhibiting a lateral extent that exceeds a lateral extent of the inner surface of the first sleeve element;

a second retention flange formed in the piston element surface adjacent to the second end region of the first sleeve element and exhibiting a lateral extent that exceeds the lateral extent of the inner surface of the first sleeve element;

a third retention flange formed in the piston element surface adjacent to the first end region of the second sleeve element and exhibiting a lateral extent that exceeds a lateral extent of the inner surface of the second sleeve element; and

a fourth retention flange formed in the piston element surface adjacent to the second end region of the second sleeve element and exhibiting a lateral extent that exceeds the lateral extent of the inner surface of the second sleeve element.

23. The seal assembly of claim 15,

wherein the portion of the first end region of the first sleeve element configured to be biased laterally into the first recess is configured to be biased in response to contact between the sealing feature of the first sleeve element and the bore surface; and

wherein the portion of the first end region of the second sleeve element configured to be biased laterally into second recess is configured to be biased in response to contact between the sealing feature of the second sleeve element and the bore surface.

24. The seal assembly of claim 15, further comprising:

a first energizer positioned generally within the first recess, the energizer configured to contact at least a portion of the inner surface of the first sleeve element; and

a second energizer positioned generally within the second recess, the energizer configured to contact at least a portion of the inner surface of the second sleeve element.

25. The seal assembly of claim 24, wherein the first and second energizer each comprise a material selected from the group consisting of a thermoplastic elastomer and a thermoset elastomer.

26. The seal assembly of claim 24, further comprising:

a pressure relief structure configured and placed to allow pressurized fluid or gas acting on at least one of the inner surface and the outer surface of at least one of the first sleeve element and the second sleeve element to move past at least one of the first and second energizers, respectively.

27. The seal assembly of claim 26, wherein the first recess and the first energizer are sized and configured to allow flow about the first energizer when the first energizer occupies a first range of positions generally within its recess and prevent flow thereabout when the first energizer occupies a second range of positions generally within its recess.

28. The seal assembly of claim 26, wherein the pressure relief structure comprises at least one protrusion or at least one groove formed on a surface of at least one of the first and second energizers.

29. The seal assembly of claim 24, further comprising a pressure equalizing structure configured to allow pressure communication between the inner surface of at least one of the first and second sleeve element and the outer surface thereof, respectively.

30. The seal assembly of claim 29, wherein the pressure equalizing structure comprises at least one aperture extending between the inner surface of at least one of the first or second sleeve element and the outer surface thereof, respectively.

31. The seal assembly of claim 15, wherein the first sleeve element, the second sleeve element, the first recess, and the second recess are each sized and configured to promote a selected amount of deflection of the first end region of the first sleeve element into the first recess and a selected amount of deflection of the first end region of the second sleeve element into the second recess.

32. A seal assembly for sealing between a piston element surface and a bore surface disposed thereabout comprising:

a piston element having a surface;

a first sleeve element positioned between the piston element surface and a bore surface disposed thereabout, the first sleeve element having an inner surface, an outer surface, a first end region, and a second end region;

a second sleeve element positioned between the piston element surface and the bore surface, the second sleeve element having an inner surface, an outer surface, a first end region, and a second end region; and

a first recess and a second recess, wherein both the first and second recess are formed in the bore surface;

wherein at least a portion of the first end region of the first sleeve element is laterally adjacent to the first recess and configured to be biased laterally thereinto;

wherein at least a portion of the first end region of the second sleeve element is laterally adjacent to the second recess and configured to be biased laterally thereinto;

wherein the first sleeve element includes a sealing feature extending from the inner surface thereof, proximate to the portion of the first end region configured to be biased laterally into the first recess, the sealing feature configured to sealingly engage against the piston element surface; and

wherein the second sleeve element includes a sealing feature extending from the inner surface thereof, proximate to the portion of the first end region configured to be biased laterally into the second recess, the sealing feature configured to sealingly engage against the piston element surface.

33. The seal assembly of claim 32, wherein the first sleeve element and the second sleeve element each comprise a material selected from the group consisting of polyamide, polytetrafluoroethelene (PTFE), acetal, polyethelene, and polyurethane.

34. The seal assembly of claim 32, further comprising:

a first depression formed in the first sleeve element; and

a second depression formed in the second sleeve element;

wherein the first depression is positioned proximate to the sealing feature of the first sleeve element and the second depression is positioned proximate to the sealing feature of the second sleeve element.

35. The seal assembly of claim 32,

wherein at least a portion of the inner surface of the first sleeve element is configured as a bearing surface and at least a portion of the inner surface of the second sleeve element is configured as a bearing surface.

36. The seal assembly of claim 35, wherein the bearing surface of the first sleeve element and the bearing surface of the second sleeve element are each sized and configured to conformally engage the piston element surface.

37. The seal assembly of claim 32, wherein the first sleeve element and the second sleeve element each comprise a material providing at least one of resilient elongation and resilient compression of about 2% or more.

38. The seal assembly of claim 32, wherein the outer surface of the first sleeve element fits interferingly against the bore surface and the outer surface of the second sleeve element fits interferingly against the bore surface.

39. The seal assembly of claim 32, further comprising

a first retention flange formed in the bore surface adjacent to the first end region of the first sleeve element and exhibiting a lateral extent less than a lateral extent of the outer surface of the first sleeve element;

a second retention flange formed in the bore surface adjacent to the second end region of the first sleeve element and exhibiting a lateral extent less than a lateral extent of the outer surface of the first sleeve element;

a third retention flange formed in the bore surface adjacent to the first end region of the second sleeve element and exhibiting a lateral extent less than a lateral extent of the outer surface of the second sleeve element; and

a fourth retention flange formed in the bore surface adjacent to the second end region of the second sleeve element and exhibiting a lateral extent less than a lateral extent of the outer surface of the second sleeve element.

40. The seal assembly of claim 32,

wherein the portion of the first end region of the first sleeve element configured to be biased laterally into the first recess is configured to be biased in response to contact between the sealing feature of the first sleeve element and the piston element surface; and

wherein the portion of the first end region of the second sleeve element configured to be biased laterally into second recess is configured to be biased in response to contact between the sealing feature of the second sleeve element and the piston element surface.

41. The seal assembly of claim 32, further comprising:

a first energizer positioned generally within the first recess, the energizer configured to contact at least a portion of the outer surface of the first sleeve element; and

a second energizer positioned generally within the second recess, the energizer configured to contact at least a portion of the outer surface of the second sleeve element.

42. The seal assembly of claim 41, wherein the first and second energizer each comprise a material selected from the group consisting of a thermoplastic elastomer and a thermoset elastomer.

43. The seal assembly of claim 41, further comprising:

a pressure relief structure configured and placed to allow pressurized fluid or gas acting on at least one of the inner surface and the outer surface of at least one of the first sleeve element and the second sleeve element to move past at least one of the first and second energizers, respectively.

44. The seal assembly of claim 43, wherein the first recess and the first energizer are sized and configured to allow flow about the first energizer when the first energizer occupies a first range of positions generally within its recess and prevent flow thereabout when the first energizer occupies a second range of positions generally within its recess.

45. The seal assembly of claim 43, wherein the pressure relief structure comprises at least one protrusion or at least one groove formed on a surface of at least one of the first and second energizers.

46. The seal assembly of claim 41, further comprising a pressure equalizing structure configured to allow pressure communication between the inner surface of at least one of the first and second sleeve element and the outer surface thereof, respectively.

47. The seal assembly of claim 46, wherein the pressure equalizing structure comprises at least one aperture extending between the inner surface of at least one of the first or second sleeve element and the outer surface thereof, respectively.

48. The seal assembly of claim 32, wherein the first sleeve element, the second sleeve element, the first recess, and the second recess are each sized and configured to promote a selected amount of deflection of the first end region of the first sleeve element into the first recess and a selected amount of deflection of the first end region of the second sleeve element into the second recess.

49. A seal assembly for sealing between a piston element and a bore surface disposed thereabout comprising:

a piston element having a surface;

a sleeve element positioned between the piston element surface and a bore surface disposed thereabout, the sleeve element having an inner surface, an outer surface, a first end region, and a second end region; and

a first recess formed in the piston element surface;

wherein at least a portion of the first end region of the sleeve element is laterally adjacent to the first recess and configured to be biased laterally thereinto;

wherein the sleeve element includes a first sealing feature extending from the outer surface thereof, proximate to the portion of the first end region configured to be biased laterally into the first recess, the sealing feature configured to sealingly engage against the bore surface.

50. The seal assembly of claim 49, wherein the sleeve element comprises a material selected from the group consisting of polyamide, polytetrafluoroethelene (PTFE), acetal, polyethelene, and polyurethane.

51. The seal assembly of claim 49, further comprising:

a first depression formed in the sleeve element, wherein the first depression is positioned proximate to the first sealing feature.

52. The seal assembly of claim 49,

wherein at least a portion of the outer surface of the sleeve element is configured as a bearing surface.

53. The seal assembly of claim 52, wherein the bearing surface of the sleeve element is sized and configured to conformally engage the bore surface.

54. The seal assembly of claim 49, wherein the sleeve element comprises a material providing at least one of resilient elongation and resilient compression of about 2% or more.

55. The seal assembly of claim 49, wherein the inner surface of the sleeve element fits interferingly against the outer surface of the piston element.

56. The seal assembly of claim 49, further comprising

a first retention flange formed in the piston element surface and adjacent to the first end region of the sleeve element, the first retention flange exhibiting a lateral extent that exceeds a lateral extent of the inner surface of the sleeve element; and

a second retention flange formed in the piston element surface and adjacent to the second end region of the sleeve element, the second retention flange exhibiting a lateral extent that exceeds a lateral extent of the inner surface of the sleeve element.

57. The seal assembly of claim 49,

wherein the portion of the first end region of the sleeve element configured to be biased inwardly into the laterally adjacent first recess is configured to be biased in response to contact between the first sealing feature of the sleeve element and the bore surface.

58. The seal assembly of claim 49, further comprising:

a second recess, wherein the second recess is formed in the piston element surface;

wherein at least a portion of the second end region of the sleeve element is laterally adjacent to the second recess and configured to be biased laterally thereinto;

wherein the sleeve element includes a second sealing feature proximate to the portion of the second end region configured to be biased laterally into the second recess, the second sealing feature configured to sealingly engage against the bore surface.

59. The seal assembly of claim 58, further comprising

a first retention flange formed in the piston element surface and adjacent to the first end region of the sleeve element, the first retention flange exhibiting a lateral extent that exceeds a lateral extent of the inner surface of the sleeve element; and

a second retention flange formed in the piston element surface and adjacent to the second end region of the sleeve element, the second retention flange exhibiting a lateral extent that exceeds a lateral extent of the inner surface of the sleeve element.

60. The seal assembly of claim 59,

wherein the portion of the first end region of the sleeve element configured to be biased inwardly into the laterally adjacent first recess is configured to be biased in response to contact between the first sealing feature of the sleeve element and the bore surface, the first recess formed in the piston element surface; and

wherein the portion of the second end region of the sleeve element configured to be biased inwardly into the laterally adjacent second recess is configured to be biased in response to contact between the second sealing feature of the sleeve element and the bore surface, the second recess formed in the piston element surface.

61. The seal assembly of claim 58, further comprising:

a third recess formed in the piston element surface, the third recess disposed axially between the first and second recesses; and

an energizer positioned generally within the third recess, the energizer configured to contact the inner surface of the sleeve element.

62. The seal assembly of claim 58, further comprising

a first energizer positioned generally within the first recess, the energizer configured to contact at least a portion of the inner surface of the sleeve element; and

a second energizer positioned generally within the second recess, the energizer configured to contact at least a portion of the inner surface of the sleeve element.

63. The seal assembly of claim 62, wherein the first and second energizer each comprise a material selected from the group consisting of a thermoplastic elastomer and a thermoset elastomer.

64. The seal assembly of claim 62, further comprising

a pressure relief structure designed to allow pressurized fluid or gas acting on at least one of the inner surface and the outer surface of the sleeve element to move past at least one of the first or second energizers.

65. The seal assembly of claim 64, wherein at least the first recess and the first energizer are mutually sized and configured to allow flow about the first energizer when the first energizer occupies a first range of positions generally within the first recess and prevent flow thereabout when the first energizer occupies a second range of positions generally within the first recess.

66. The seal assembly of claim 64, wherein the pressure relief structure comprises at least one protrusion or at least one groove formed on a surface of at least one of the first or second energizer.

67. The seal assembly of claim 49, further comprising a pressure equalizing structure configured to allow pressure communication between the inner surface of the sleeve element and the outer surface thereof.

68. The seal assembly of claim 67, wherein the pressure equalizing structure comprises at least one aperture extending between the inner surface of the sleeve element and the outer surface thereof.

69. The seal assembly of claim 58, wherein the sleeve element, the first recess, and the second recess are each sized and configured to promote a selected amount of deflection of the first end region of the sleeve element into the first recess and a selected amount of deflection of the second end region of the sleeve element into the second recess.

70. A seal assembly for sealing between a piston element and a bore surface disposed thereabout comprising:

a piston element having a surface;

a sleeve element positioned between the piston element surface and a bore surface disposed thereabout, the sleeve element having an inner surface, an outer surface, a first end region, and a second end region; and

a first recess formed in the bore surface;

wherein at least a portion of the first end region of the sleeve element is laterally adjacent to the first recess and configured to be biased laterally thereinto;

wherein the sleeve element includes a first sealing feature extending from the inner surface thereof, proximate to the portion of the first end region configured to be biased laterally into the first recess, the sealing feature configured to sealingly engage against the bore surface.

71. The seal assembly of claim 70, wherein the sleeve element comprises a material selected from the group consisting of polyamide, polytetrafluoroethelene (PTFE), acetal, polyethelene, and polyurethane.

72. The seal assembly of claim 70, further comprising:

a first depression formed in the sleeve element, wherein the first depression is positioned proximate to the first sealing feature.

73. The seal assembly of claim 70,

wherein at least a portion of the inner surface of the sleeve element is configured as a bearing surface.

74. The seal assembly of claim 73, wherein the bearing surface of the sleeve element is sized and configured to conformally engage the piston element surface.

75. The seal assembly of claim 70, wherein the sleeve element comprises a material providing at least one of resilient elongation and resilient compression of about 2% or more.

76. The seal assembly of claim 70, wherein the outer surface of the sleeve element fits interferingly against the bore surface.

77. The seal assembly of claim 70, further comprising

a first retention flange formed in the bore surface and adjacent to the first end region of the sleeve element, the first retention flange exhibiting a lateral extent less than a lateral extent of the outer surface of the sleeve element; and

a second retention flange formed in the bore surface and adjacent to the second end region of the sleeve element, the second retention flange exhibiting a lateral extent less than a lateral extent of the outer surface of the sleeve element.

78. The seal assembly of claim 70,

wherein the portion of the first end region of the sleeve element configured to be biased inwardly into the laterally adjacent first recess is configured to be biased in response to contact between the first sealing feature of the sleeve element and the piston element surface.

79. The seal assembly of claim 70, further comprising:

a second recess, wherein the second recess is formed in the bore surface;

wherein at least a portion of the second end region of the sleeve element is laterally adjacent to the second recess and configured to be biased laterally thereinto;

wherein the sleeve element includes a second sealing feature proximate to the portion of the second end region configured to be biased laterally into the second recess, the second sealing feature configured to sealingly engage against the piston element surface.

80. The seal assembly of claim 79, further comprising

a first retention flange formed in the bore surface and adjacent to the first end region of the sleeve element, the first retention flange exhibiting a lateral extent less than a lateral extent of the outer surface of the sleeve element; and

a second retention flange formed in the bore surface and adjacent to the second end region of the sleeve element, the second retention flange exhibiting a lateral extent less than a lateral extent of the outer surface of the sleeve element.

81. The seal assembly of claim 80,

wherein the portion of the first end region of the sleeve element configured to be biased inwardly into the laterally adjacent first recess is configured to be biased in response to contact between the first sealing feature of the sleeve element and the piston element surface; and

wherein the portion of the second end region of the sleeve element configured to be biased inwardly into the laterally adjacent second recess is configured to be biased in response to contact between the second sealing feature of the sleeve element and the piston element surface.

82. The seal assembly of claim 79, further comprising:

a third recess formed in the piston element surface, the third recess disposed axially between the first and second recesses; and

an energizer positioned generally within the third recess, the energizer configured to contact the outer surface of the sleeve element.

83. The seal assembly of claim 79, further comprising

a first energizer positioned generally within the first recess, the energizer configured to contact at least a portion of the outer surface of the sleeve element; and

a second energizer positioned generally within the second recess, the energizer configured to contact at least a portion of the outer surface of the sleeve element.

84. The seal assembly of claim 83, wherein the first and second energizer each comprise a material selected from the group consisting of a thermoplastic elastomer and a thermoset elastomer.

85. The seal assembly of claim 83, further comprising

a pressure relief structure designed to allow pressurized fluid or gas acting on at least one of the inner surface and the outer surface of the sleeve element to move past at least one of the first or second energizers.

86. The seal assembly of claim 85, wherein at least the first recess and the first energizer are mutually sized and configured to allow flow about the first energizer when the first energizer occupies a first range of positions generally within the first recess and prevent flow thereabout when the first energizer occupies a second range of positions generally within the first recess.

87. The seal assembly of claim 85, wherein the pressure relief structure comprises at least one protrusion or at least one groove formed on a surface of at least one of the first or second energizer.

88. The seal assembly of claim 70, further comprising a pressure equalizing structure configured to allow pressure communication between the inner surface of the sleeve element and the outer surface thereof.

89. The seal assembly of claim 88, wherein the pressure equalizing structure comprises at least one aperture extending between the inner surface of the sleeve element and the outer surface thereof.

90. The seal assembly of claim 79, wherein the sleeve element, the first recess, and the second recess are each sized and configured to promote a selected amount of deflection of the first end region of the sleeve element into the first recess and a selected amount of deflection of the second end region of the sleeve element into the second recess.

91. A method of forming a seal between a bore surface and a piston element surface, the method comprising:
providing a piston element;
providing a bore having a surface;
providing a sleeve element having an inner surface, an outer surface, an end region, and a sealing feature disposed generally within the end region;
providing a recess formed in one of the bore surface and the piston element surface;
disposing the sleeve element between the piston element and the bore surface;
biasing at least a portion of the first end region of the sleeve element into the recess.

92. The method of claim 91, wherein disposing the sleeve element between the piston element and the bore surface comprises elongating the sleeve element to increase the size of an interior surface thereof and disposing the sleeve element about the piston element.

93. The method of claim 91, wherein disposing the sleeve element between the piston element and the bore surface comprises compressing the sleeve element to reduce the size of an exterior surface thereof and disposing the sleeve element within the bore surface.

94. The method of claim 91, further comprising supporting the at least a portion of the end region of the sleeve element generally opposite to biasing thereof into the recess.

95. The method of claim 94, wherein supporting the at least a portion of the end region of the sleeve element comprises resiliently supporting the end region of the sleeve element.

96. The method of claim 95, wherein resiliently supporting the end region of the sleeve element comprises disposing an energizer generally within the recess that is compressed in response to biasing of the at least a portion of the end region into the recess.

97. The method of claim 91, further comprising selectively relieving pressure acting on at least one of the inner surface and the outer surface of the sleeve element.

98. The method of claim 91, further comprising equalizing a pressure acting on the inner surface of the sleeve element and a pressure acting on the outer surface of the sleeve element.

99. The method of claim 91, wherein biasing at least a portion of the first end region comprises biasing at least a portion of the first end region into a recess formed in the piston element surface by sealingly engaging the bore surface against the sealing feature of the sleeve element.

100. The method of claim 91, wherein biasing at least a portion of the first end region comprises biasing at least a portion of the first end region into a recess formed in the bore surface by sealingly engaging the piston element surface against the sealing feature of the sleeve element.